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Observations on the Nest-site Behavior of Melissodes composita Tucker and its Parasites, with Notes on the Communal Use of Nest Entrances (Hymenoptera: Apoidea)

By PAUL D. HURD, JR. and E. GORTON LINSLEY,
University of California, Berkeley

In early September of 1958 while in residence at the Southwestern Research Station near Portal, Arizona,[1] a nesting site of *Melissodes composita* Tucker [2] was discovered. Because of the unusual physical arrangement of the burrows and the modified behavior of the adult bees and their parasites, a brief account of the circumstances is offered in the hope that it may possibly contribute to current theory as to the evolution of behavior patterns in these and other bees (cf. Michener and Lange, 1958).

The nesting area was situated in grassland on the upper portion of a small, gently sloping plateau amidst the open oak-juniper woodland which overlooks the Station from the northeasterly slopes of Cave Creek Canyon. The elevation is approximately 6,500 ft. Growing among the grasses on the lower portions and margins of the plateau were two conspicuous composites, *Aster tanacetifolius* HBK and *Haplopappus gracilis* (Nutt.) Gray,[3] whose flowers were being visited for nectar and pollen by a large number of *Melissodes* and an unidentified

[1] We are indebted to Dr. Mont A. Cazier, Director of the Southwestern Research Station, American Museum of Natural History, for facilitating these and other investigations undertaken while in residence at the Southwestern Research Station during August and September, 1958.

[2] Determined by Dr. Wallace E. LaBerge, Iowa State University, Ames.

[3] The plant identifications were made by Helen K. Sharsmith, University of California Herbarium, Berkeley.

species of *Xenoglossodes*. Several parasitic bees, *Triepeolus helianthi* (Robertson), were also among them and by observing the activities of one of the relatively slow flying *Triepeolus* females as she left the flowers, we were able to locate the nesting site of the *Melissodes*. This occupied an area of approximately 16 square feet and included twelve irregularly spaced and irregularly shaped ground openings. They were devoid of tumuli, situated inconspicuously in small barren interspaces in the grassland, and were used communally by the bees.

During the warmer part of the morning (10:30 A.M.–11:30 A.M. MST), numerous pollen laden females were observed returning to the site, circling briefly, and entering one of the communal openings. Sometimes several females would enter the same opening within a few seconds of each other and commonly others, having already deposited their pollen stores, would be departing at the same time, requiring a returning female to pause near the entrance so as to permit a female to leave. At times females waiting within the entrance would remain there for relatively long periods of time thus effectively blocking it until they departed. If a *Triepeolus* female approached an opening and found it occupied she would hastily retreat. Similar reactions were noted when ovipositing bombyliid females, *Villa* (*Paravilla*) spp.[4] began to hover above an occupied burrow entrance. Even so, when an entrance was unoccupied, if only for a brief interval, *Triepeolus*[5] females would enter and, unless forced out, remain within for varying periods of time. In one instance one of these females spent 17 minutes underground. As many as three females of *Triepeolus* were observed simultaneously investigating a single entrance without displaying antagonistic behavior toward one another. Nor did they exhibit aggressive behavior toward *Villa* females, even when the

[4] Determined by Dr. F. R. Cole, University of California, Berkeley, as belonging to the group of *V.* (*P.*) *tricellula* Cole and *V.* (*P.*) *apicola* Cole which have been reared from cells of species of *Diadasia* [Cole (1952)].

[5] Although we have identified these from the literature as *T. helianthi* Robertson, they may well prove to be subspecifically or specifically distinct. The Robertson species has been recorded from Wisconsin by Graenicher (1905) as a parasite of *Melissodes trinodis* Robertson, a bee with more orthodox nesting habits.

latter hovered immediately behind or followed them about the nesting site. Miltogramine flies were observed in the nest area, but none were seen to enter the burrows.

While these activities were taking place, *Melissodes* males coursed continuously and erratically over the nesting site within an inch or so of the ground. Several times one was observed to pounce upon a returning pollen laden female, forcing her to the ground where they would mate. The resulting union was brief, usually lasting 10 to 15 seconds, although one pair remained in contact for 35 seconds during which time they moved spasmodically over the ground. Following separation the females entered one of the burrow openings and the males either resumed flight over the site or left the area.

During five days of intermittent observation (September 5–9) the greatest period of activity about the nesting site occurred between 11 A.M. and 2:30 P.M. On one occasion, an early afternoon thunder shower caused complete cessation of activity, but shortly after the storm passed the bees became active again even though the vegetation was wet and some water had drained into the burrow openings.

On the morning of September 9, a clear warm day, the first female *Melissodes* departed from one of the openings at 9:30 and returned 15 minutes later with a complete pollen load. As the morning progressed more and more females became evident and by 10:00 males had commenced their coursing flight over the site. At 10:45 the first females of *Triepeolus* and *Villa* commenced their activities over the nesting site.

In an effort to gain some idea of how many *Melissodes* females were using these communal entrances, a net was placed over the opening well before the bees became active. During the hours 9:30–11:30 A.M., 143 females were collected as they emerged, sometimes singly, more often in groups of 3–5. Occasionally one would escape and within 15 minutes or so she would return pollen laden, circle the area, and land either near or on the obstructing net. Commencing at 11:15 one of the burrows was readied for plaster of Paris pouring. Within the next 15 minutes 3 large beakers (1500 c.c.) of liquid plaster of Paris were poured in it without filling it.

Upon returning to the nesting site at 1:30 with additional

plaster of Paris several more burrow entrances were prepared and similar large quantities of liquid plaster were poured into them. Since it was clear that the openings lead to extensive underground cavities, one of the partly poured burrows was finally selected for excavation. The entrance was oval in outline measuring 7 × 12 mm. The burrow at a depth of .5 cm. assumed a circular outline with a diameter of 5 mm. At about this point it began to turn gradually and within the next 2.5 cm. formed a semicircular curvature on the wall of the excavation so that at a depth of 3 cm. the descending portion of the burrow was again in line with the burrow opening. It continued downward for another 2.5 cm. with its lower end opening into an earth fissure which clearly extended downward and laterally for some distance. Excavation of another burrow opening resulted in similar findings and demonstrated that the irregularities within the first 2 or 3 cm. of the burrow were occasioned by small rocks and pebbles in the 5 to 6 cm. mantle of soil which overlaid the heavily fissured adobe-like substrate. Exploratory excavations along the fissures in this underlying substrate revealed several bees at a depth of 32–40 cm. from the ground surface and a number of old cells from the preceding year. Further digging in this extremely hard, yet moist, adobe-like material produced one newly constructed cell series at a depth of 36 cm. The tunnel, 5 mm. in diameter, extended inward, horizontally from a fissure for a distance of 10 cm. Two cells, each measuring 6 mm. in internal diameter (widest) by 15 mm. in length, were appended at the terminus and lay in the same plane as the burrow. One of the cells was provisioned and sealed and contained a first instar larva. The other cell was still in the process of being provisioned. On the basis of nests from previous seasons it was learned that the horizontal tunnels leading inward from the fissures had been excavated in the 32–40 cm. depth level and varied in length from 10 to 15 cm. Each of these tunnels terminated in 4–6 cells.

Our excavation opened some 9 square feet of the nesting site and extended downward to a depth of 2 to 3 feet, before it was necessary to terminate the digging. It was obvious that many of the fissures which varied in width from .5 cm. to 1.5 cm.

extended downward beyond the 2–3 foot level and laterally for indeterminate distances. How far laterally the bees extended their underground activities can only be conjectured. Since only one newly constructed nest was found in the removal of 18 or more cubic feet of earth and since 143 females were collected from just one of the 12 communal nest entrances, it must have been considerable. The number of *Melissodes* using the 12 underground entrances varied somewhat from entrance to entrance, but if only 100 on the average used each, the nesting site must have contained at least 1200 females.

Discussion

Two aspects of these observations would appear to require further comment. First, to our knowledge, this is the first recorded instance of North American eucerine bees utilizing a common entrance, although this type of behavior has been previously recorded in the exomalopsine genus *Exomalopsis* [Hicks (1936); Linsley, MacSwain and Smith (1954); Rozen and MacNeill (1957)]. Females of this last genus apparently employ two different methods of reaching the level at which they build their cells: (a) by the utilization of pre-existing passageways, such as soil cracks extending downward or burrows of prior generations or those of other bee species, or (b) by utilizing a common nest entrance. Further investigation may reveal the same situation in *M. composita,* which was found nesting in very hard, cracked soil, overlaid by a mantle. This habit, apparently developed independently to meet similar physical problems in the nesting area, would also appear to have potentialities as an incipient stage toward a more complex social behavior than is usually evident in anthophorid bees.

The second aspect is the behavioral response of the parasites to the problem created by the busy communal entrance, blocked much of the time by females entering and leaving, and by the relatively long distances from the entranceway to the cells being provisioned by the bee. The unusual behavior patterns of the females of *Triepeolus* are marked departures from those characteristic of species which oviposit in cells of completely solitary

bees. This was reflected in the fact that several females would poise around a single entrance awaiting the opportunity to enter, the lack of antagonism toward each other, and the long periods of time during which they would stay below the surface presumably investigating numerous crevices and burrows. Their ability to successfully parasitize the *Melissodes* under these conditions was emphasized by the relatively large number of individuals present at the site. The same was true of the bombyliid flies, although the difficulties associated with successful parasitism in their case must have been much greater. Since the flies did not pass through the entrance to oviposit, primary larvae hatching near the opening had to traverse long distances to reach the open cells and pupal flies had to work their way to the communal opening from the intricate underground cracks for emergence. Empty pupal cases were found in numbers around the communal openings but none were encountered in underground spaces during excavation. It is interesting to speculate as to whether these modifications of more usual behavior patterns reflect adaptations to the habits of this particular species of bee, or whether they are within the range of normal response of these parasites to variations in nesting habits of their hosts.

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A New Genus and Three New Species of Phytoseiid Mites from Mexico with Collection Records on Phytoseius plumifer (C. & F.) and P. macropilis (Banks)

By Donald De Leon, Pensacola, North Carolina

Phytoseiids are mostly predaceous mites preying chiefly on plant feeding mites. The family is represented in Mexico by a rather large number of species some of which are widespread and common.

The genus *Phytoseius* includes two species, the rediscovered *plumifer* (C. & F.) (Chant, 1957) and the ubiquitous *macropilis* (Banks). Recently the writer collected *plumifer* on the east coast of Mexico and on Key Largo, Florida. A third species, more common and with a broader distribution than *plumifer* in Mexico, is described below.

Chant (*l. c.*) erected the genus *Proprioseius* for two undescribed species from the eastern United States; a third species is added to the group in this paper.

All measurements are in microns and are averages unless the variation from the average is more than ten percent; if so, the range is given.

Phytoseius nahuatlensis, n. sp. (Figures 3–4)

P. nahuatlensis resembles *P. plumifer* (C. & F.) as redescribed and figured by Chant (*l. c.*) in general facies, but differs from it chiefly by having a large pore behind M1 and by having shorter lateral setae.

Female: Dorsal shield 260 long, 131 wide, with faint imbrications along the anterolateral margins, faint rugosities anteromedially, and with 16 pairs of setae as follows: Eight laterals (including S1 which is on the shield and close to L4), two medians, and six dorsals. The lengths of these setae follow: L1 36, L2 12, L3 31–40, L4 13–18, L5 46, L6 57–69, L7 42–61; M1 9, M2 31–44; D1 20, D2–D6 9–14; all setae except M1 and D2–D6 and apparently L2 pectinate. S1 30 and VL1 38–48

long, both pectinate. Sternal shield with three pairs of setae; ventrianal shield strongly constricted laterally and with three pairs of preanal setae. Fixed digit with three teeth just proximal of terminal hook, movable digit with one tooth. Genu, tibia and metatarsus of leg IV each with a slender, tapering macroseta about 18, 18, and 20 long respectively, the tips not or scarcely enlarged.

MALE: Resembles female; dorsal shield 206 long, about 118 wide.

Holotype: Female, Tuxtla Gutierrez, Chiapas, January 15, 1957 (D. De Leon), from *Lonchocarpus rugosus. Paratypes:* One male, same locality as for holotype, but from *Rhus schideana;* one female, Veracruz, Ver., December 25, 1956, from *Guazuma tomentosa;* three females, Tuxtla Gutierrez, January 12, 1957, from an unknown host. Additional specimens were collected from the latter locality on *Pluchea odorata;* from Cordoba, Ver., February 4 and 5, 1957, from *Heliocarpus tomentosa* and *Luehea candida* and from Santa Maria del Oro, Nay., March 24, 1957, from an unknown host.

Specimens which closely resemble the above species, but are larger (dorsal shield 266–288 long), with most of the lateral setae longer (L1 38, L2 10, L3 46, L4 9, L5 60, L6 72–90, L7 58–72; M2 49–60), and with the macrosetae of leg IV somewhat longer, coarser and with the tips distinctly enlarged were collected at Ixtlan del Rio, Nay., March 24, from an unknown host; at Tepic, Nay., from *Lippia umbellata;* Mirador del Aguila (near Tepic), from *Guazuma tomentosa;* and at San Blas, Nay., April 4, from *Thevetia* sp. In addition three specimens collected on the east coast of Mexico in December 1956 from *Guazuma* sp. and *Hamelia patens* have very long lateral setae as follows: L1 47, L2 10, L3 60, L4 12, L5 78, L6 90–102, L7 74–81; M2 68. The macrosetae of leg IV of these last three mentioned specimens are large, coarse and with strongly expanded tips. Further work is necessary to determine whether three species are involved or whether all these specimens are variations of a single plastic species.

Phytoseius plumifer (C. & F.)

Collection records for this species follow:

Reynosa, Tam., December 18, 1956, from *Cordia boissieri* and *Melochia tomentosa.* Ciudad Victoria, Tam., December 20, 1956, from an unknown host. Tamazunchale, S. L. P., December 21, 1956, from *Eriobotrya japonica.* Veracruz, Ver., December 25, 1956, from *Guazuma tomentosa.* Tuxtla Gutierrez, Chiapas, January 15, 1957, from *Cecropia peltata, Achras zapota,* and *Morus alba.* Key Largo, Florida, USA, June 1956 from *Callicarpa americana.*

Phytoseius macropilis (Banks)

Collection records for this species in Mexico follow:

Minatitlan, Ver., January 8, 1957, from an unknown host. Ocozocoatla, Chiapas, January 28, 1957, from sangre toro.

Proprioseius mirandai, n. sp. (Figures 1–2)

P. mirandai is readily distinguished from the two other species in the genus (*P. meridionalis* Chant and *P. clancyi* Chant) by having L4, L7, and M2 much longer and more slender than they are in the latter two species.

FEMALE: Body whitish, elongate; dorsal shield rugose, 277 long, 148 wide, with 14 pairs of setae as follow: Seven laterals, two medians, and five dorsals (D5 missing). Dorsal shield setae of the following lengths: L1–L3 14–18, L4 81, L5 13, L6 20, L7 111; M1 5, M2 94 (L4, L7, and M2 strongly pectinate); D1 27, D2–D6 7–11; S1 31 (pectinate), S2 18, VL1 71 (pectinate). Peritremata extending forward to D1. Sternal shield with three pairs of setae; ventrianal shield with three pairs of preanal setae, no pores, about 100 long and 55 wide with the sides constricted and surrounded by four pairs of interscutal setae, including VL1. Two pairs of metapodal shields, the primary one about 19 long; a pair of small circular shields between VL1. Fixed digit with five or six teeth, movable digit with one tooth. Metatarsus of leg IV with a rapidly tapering macroseta about 19 long.

MALE: Resembles female. Dorsal shield 210 long, 125 wide; L4 45, L7 50, and M2 47 long, all pectinate.

Holotype: Female, Tepic, Nay., March 25, 1957 (D. De Leon), from *Lippia umbellata. Paratypes:* One female, same data as for holotype; one male, San Blas, Nay., April 6, 1957, from agualama; one male and one female December 25, 1956, Veracruz, Ver., from *Guazuma tomentosa;* two females, Cordoba, Ver., from *Croton draco.* Additional specimens were collected from *Hamelia patens,* Cordoba; from a composite, Matias Romero, Oax., January 30, 1957; and from *Polygonum* sp., San Blas, Nay., March 31, 1957.

I am not certain that these mites are predaceous; they may be facultative predators, as two specimens on a composite appeared to be sucking sap from the leaf—no other mites were observed on the leaf.

The mite is named for Dr. Faustino Miranda of the Instituto de Biologia, Mexico, D. F., who kindly identified most of the host plants I collected on the east coast of Mexico and in Oaxaca.

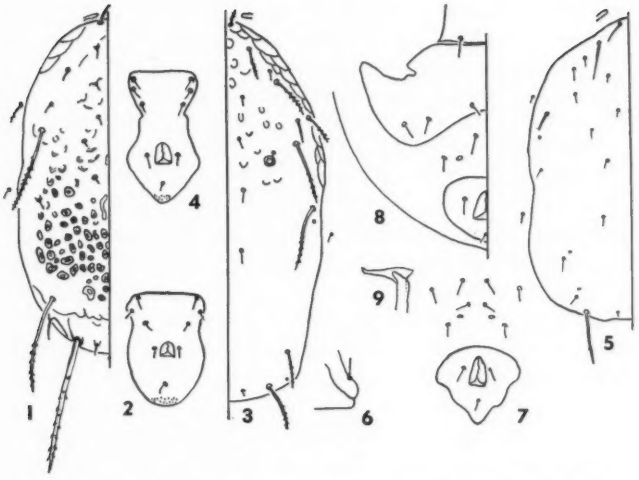
TYPHLOSEIOPSIS, n. gen.

Phytoseiids with dorsal shield smooth or nearly so, with at least five pairs of anterolateral setae, and with D2–D6 minute; female without ventrianal shield (only anal shield present), male with ventral shield separated from anal shield; genua I–IV, tibia IV, and metatarsus IV each with a macroseta. The absence of a ventrianal shield in the female and the separated ventral and anal shields in the male are distinguishing characters.

Type: *Typhloseiopsis theodoliticus,* n. sp.

Typhloseiopsis theodoliticus, n. sp. (Figures 5–9)

FEMALE: Body light tan; dorsal shield 308 long, 201 wide with 16 pairs of setae as follows: Eight lateral (L4 is distinctly medial of a line drawn between L3 and L5), two median, and six dorsal. Lengths of setae as follows: L1 33, L2—L4 7–9, L5 9–18 (10 ♀♀, 1 ♀ with L5 44), L6 9–13, L7 8, L8 56; M1 8, M2 12; D1 21–29, D2–D6 7–11; S1 14, S2 10; VL1 38.



Proprioscius mirandai, n. sp.: 1, dorsal shield; 2, ventrianal shield. *Phytoseius nahuatlensis*, n. sp.: 3, dorsal shield; 4, ventrianal shield. *Typhloseiopsis theodoliticus*, n. sp.: 5, dorsal shield; 6, posterolateral margin of genital shield; 7, anal shield of female and the four pairs of preanal setae and the pair of pores of the ventrianal area; 8, ventral and anal shields of male; 9, distal end of spermatophore bearer.

Sternal shield longer than wide, very faintly reticulate and with three pairs of setae; ventral shield missing, not fused with anal shield; four pairs of preanal setae and a pair of small pores anterior of anal shield; anal shield 59 long, 63 wide with three setae and of shape shown in figure; three pairs of setae including VL1 surrounding ventrianal area; two pairs of small, narrowly oval metapodal shields. Legs slender, with macrosetae of the following lengths: Genu I 36, genu II 27–36, genu III 35, genu IV 54; tibia IV 27–36; metatarsus IV 43–63; all macrosetae slender and tapering to a fine point.

MALE: Resembles female, but L5 22 long and ventral shield present although not fused with anal shield; three pairs of setae on ventral shield and two pairs of setae and a pair of pores

between ventral and anal shields; anal shield 45 wide, 32 long of shape shown in figure. Dorsal shield 248 long, 163 wide.

Holotype: Female, San Blas, Nay., March 28, 1957 (D. De Leon), from *Paullinia fuscescens. Paratypes:* One male, three females, San Blas, Nay., March 31, 1957, from *Combretum farinosum;* two females, Cordoba, Ver., February 4, 1957, from *Miconia glaberrima.* Additional specimens were collected in the San Blas area from *Licaria* sp., *Annona* sp., banana, and a lauraceous tree, and at Tuxtla Gutierrez, Chiapas, from *Piper* sp.

These mites were found in association with species of *Brevipalpus* and *Tenuipalpus.*

Holotypes of the above species are in the writer's collection, paratypes will be deposited in the University of Florida Collections, Gainesville.

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Chant, D. A. 1957. Descriptions of two new phytoseiid genera (Acarina: Phytoseiidae), with notes on *Phytoseius* Ribaga, 1902. Canad. Ent. 89 (8): 357–363.

A Synonymical List of American Himantariidae, with a Generic Key and Description of a New Genus (Chilopoda: Geophilomorpha: Himantariidae)

By Ralph E. Crabill, Jr., U. S. National Museum, Smithsonian Institution, Washington, D. C.

(*Continued from p. 126*)

The underlying key should assist in the generic allocation of many existing species and provide a framework within which forthcoming new forms may be studied. Without any doubt the future accumulation of additional information on distribution and variation will affect it profoundly: this is frankly anticipated. The reader will note that I have included *Nothobius* Cook and *Gosothrix* Chamberlin, both questionably referred to the family by Attems (1, p. 54) because of their possession of ultimate pedal pretarsi. On the basis of the original description at least of *Gosothrix* it certainly seems apparent, at least to me, that the Chamberlin genus is a true himantariid.

Key to the American Himantariid Genera [5]

1a. Ultimate legs with typical unguiform pretarsi (*Nothobius, Gosothrix*).....2

1b. Ultimate legs without pretarsi.....3

2a. Narrow *major* paratergites present at least on some segments. Ventral pore-fields present. Coxopleural pores numerous, presumably free and not concentrated in pits or fossae.....*Nothobius* Cook

2b. Major paratergites and ventral pore-fields absent. The majority of the coxopleural pores concealed, opening into pits or fossae along and beneath the edge of the sternite (and tergite?).....*Gosothrix* Chamberlin

3a. Coxopleural pores exposed, essentially uniformly distributed over most or all of the coxopleural surface. Ventral pore-fields present or absent (*Stenophilus, Arcophilus*).....4

[5] The key makes no provision for *Haplophilus subterranea* (Leach) (*sensu* Chalande & Ribaut, 1909), a widespread European form intercepted at quarantine and possibly established in this country, or for *Haplophilus grenadae* Chamb., 1912, or *Haplophilus hesperus* Chamb., 1928; the generic affinities of the latter two species are in doubt.

3b. Most or all of the coxopleural pores concealed, opening into one to several pits or into fossae lying next to and/or somewhat beneath the sternite margins. Ventral pore-fields present (*Gosophilus, Garriscaphus, Empherozoster*).....5

4a. Labrum not deeply incised medially, instead evenly arched over its entire breadth. Ventral pore-fields present, evidently on most sternites, including those of rear third of body[6].....*Arcophilus* Chamberlin

4b. Labrum medially deeply incised, not evenly arched over its entire breadth. Ventral pore-fields absent (*coloradanus, californicus*), present on anterior half of body (*rothi*), or present on most of the posterior segments as well (*audacior*).....*Stenophilus* Chamberlin

5a. Base of prehensorial claw with a small but distinct black denticle. Subcondylic sclerotic lines of prosternum absent (applies only to type-species, *oreines;* see Note A).....*Garriscaphus* Chamberlin

5b. Base of prehensorial claw without such a denticle. Subcondylic sclerotic lines absent or present (*Gosiphilus, Empherozoster*).....6

6a. Prosternal subcondylic sclerotic lines *in most* pronounced, extending to condyles. Ultimate sternite in most broader than long, usually conspicuously so. Intercalary (not major) paratergites present, at least in some species and probably in all. Antennae often flattened proximally, often attenuate distally. 1st maxillary lappets present. Anal pores absent (in type and in all known specimens.....*Gosiphilus* Chamberlin (see Notes A, B, and C.)

6b. Prosternal sclerotic lines absent, i.e., not passing across corner of prosternum toward and connecting with condyles. Ultimate pedal sternite much longer than its width at midlength. Intercalary paratergites absent, the lateral ends of intercalary tergites covered by intercalary pleurites. Antennae not attenuate distally, the more proximally articles not depressed dorso-ventrally nor subcylindrical, instead compressed on each side and distinctly longer than wide. 1st maxillary lappets absent. Anal pores present.....*Empherozoster,* New Genus

[6] The Bolivian *Stigmatogaster gracillima* Verhoeff, 1938, is questionably placed here; however, its pore-fields occur only on the anterior half of the body.

List of American Himantariidae

The following list is synonymical to the extent that a very careful study of the literature and an admittedly limited acquaintance with the American specimens are capable of making it. As will be seen, most of the species are known only from their type localities. I have listed what seem to be the valid genera, the type species with the method of fixation, the species believed at this time to be included under each generic name, synonyms, the sources and dates of publication, and a general indication of distribution. An asterisk indicates that the associated species is known only from the type locality or localities.

Arcophilus Chamberlin, 1943. (14, 10).

Type-species: *Arcophilus toltecus* Chamb., 1943. (Original designation and monotypic).

Arcophilus toltecus Chamb., 1943. (14, p. 10; Mexico: Puebla *).

? **Stigmatogaster gracillima** Verhoeff, 1938. (21, p. 126; Bolivia *).

Empherozoster Crabill, 1959.

Type-species: *Empherozoster antaeus* Crab., 1959. (Original designation and monotypic).

Empherozoster antaeus Crab., 1959. (New Mexico *).

Garriscaphus Chamberlin, 1941. (13, p. 789).

Type-species: *Garriscaphus oreines* Chamb., 1941. (Original designation).

Garriscaphus oreines Chamb., 1941. (13, p. 790; California *).

? **Garriscaphus amplus** Chamb., 1941. (13, p. 790; California *). (? = **Gosiphilus**).

Gosiphilus Chamberlin, 1912. (6, p. 671). (See Note C).

Type-species: *Strigamia laticeps* Wood, 1862, vid. infr. (= *Gosiphilus laticeps* (Wood)). (Subsequent designation of Crabill, 19, p. 88).

? Syn.: *Californiphilus* Verhoeff, 1938. (20, p. 370), with type-species *C. michelbacheri* Verhoeff, 1938. (20, p. 371). (Monotypic).

? **Garriscaphus amplus** Chamb., 1941. (13, p. 790; California *).

Gosiphilus auximus Chamb., 1938. (12, p. 254; Texas *).
Gosiphilus bakeri Chamb., 1912. (6, p. 672; California *).
Gosiphilus craterus Chamb., 1944. (15, p. 186; Mexico: Hidalgo *).
Gosiphilus euphorion Crab., 1953. (19, p. 85; Alabama *, Tennessee *, Kentucky *).

Strigamia laticeps Wood, 1862. (22, p. 49; Texas, California, Nevada [7]).

Californiphilus mexicanus Attems, 1947. (2, p. 51; Mexico *). (? = *auximus* Chamb., 1938, q.v.).

Californiphilus michelbacheri Verhoeff, 1938. (20, p. 371; California *).

Gosiphilus minor Chamb., 1912. (6, p. 671; California *).

Gosiphilus minor arizonicus Chamb., 1925. (9, p. 54; Arizona *).

Gosiphilus morelus Chamb., 1943. (14, p. 11; Mexico: Morelus *).

Gosiphilus orizabae Chamb., 1944. (15, p. 185; Mexico: Vera Cruz *).

? **Strigamia taeniopsis** Wood, 1862. (22, p. 48; Georgia, ? = California).

Gosothrix Chamberlin, 1923. (8, p. 398).

Type-species: *Gosothrix insulanus* Chamb., 1923. (Original designation and monotypic).
Gosothrix insulanus Chamb., 1923. (8, p. 398; Gulf of California *).

Nothobius Cook, 1899. (18, p. 303).

Type-species: *Nothobius californicus* Cook, 1899. (Monotypic).
Nothobius californicus Coo, 1899. (18, p. 303; California).

Stenophilus Chamberlin, 1946. (16, p. 35). (Revised, 17, p. 37).

[7] The type was collected in Texas. Chamberlin has reported the California and Nevada records, basing them upon specimens with prominent, complete prosternal sclerotic lines and circular anterior spiracles. The holotype of *laticeps*, however, lacks subcondylic sclerotic lines and has vertically elliptical spiracles. See Notes A and B.

Type-species: *Stenophilus coloradanus* Chamb., 1946. (Original designation and monotypic).
? Haplophilus audacior Chamb.,[8] 1909. (5, p. 177; Idaho *).
Meinertophilus californicus Chamb., 1930. (11, p. 297; California *).
Stenophilus coloradanus Chamb., 1946. (16, p. 35; Colorado *).
Stenophilus rothi Chamb., 1953. (17, p. 38; Oregon *, Montana *).

Generic Assignment Uncertain.

Haplophilus audacior Chamb., 1909. (5, p. 177; Idaho *).
Haplophilus hesperus Chamb., 1928. (10, p. 309; Utah *).
Haplophilus grenadae Chamb., 1912. (7, p. 435; Mississippi *, not "Missiones," auctt. lap. cal.).

Note A. Prosternal Sclerotic Lines ("chitin lines").

It is easy to misinterpret the meanings of various authors when they refer to this character. For instance, when it is stated that chitin lines (or better, prosternal sclerotic or subcondylic lines) are absent, this only means (in the case of these himantariid genera) that the lines do not pass across the anterolateral corners of the prosternum toward or to the condyles, as is the case in fig. 4. Note, however, that the lines are actually present (e), though mostly covered by the pleurites (a). To state that the lines are complete means that they connect with the condyles. Therefore we should not describe them as absent unless in fact they are. Instead, the following distinction should be made: 1) sclerotic lines passing *toward* the condyles across the prosternum, or passing toward and *connecting with* the condyles, versus; 2) sclerotic lines not passing across the prosternum toward the condyles. I suspect that all himantariid species which are said by convention to lack these lines in fact have them, though they do not migrate across the prosternal corner toward or connect with the condyles.

[8] Originally (16, p. 35) Chamberlin referred *audacior* to *Stenophilus*, even though he characterized the genus as lacking sternital pore-fields. Subsequently (17, p. 37) he altered the generic diagnosis to make provision for species with ventral pore-fields but only if they are restricted to the anterior half of the body (e.g. *rothi*). However, in 1909 he stated that *audacior* does have pore-fields on the rear body sternites.

Note B. Gosiphilus laticeps (Wood), type-species of the genus; a brief diagnosis of the holotypical specimen.

Male with 81 pairs of legs. Antennae basally flattened, distally attenuate. Prebasal plate concealed. Labrum: deeply embayed but not divided medially, teeth 9 + 10; apparently broadly fused with clypeus, at least laterally. Mandible: dentate lamella with 12–13 teeth; 7–8 pectinate lamellae, their teeth with parallel sides. 1st maxillae: telopodite bipartite, with distinct triangular lappets; deeply incised medially; coxosternum without lappets. 2nd maxillae: deeply incised medially; with a shallow midlongitudinal groove (but no suture); claw pointed, inner surface concave, with basal spines. Prosternal sclerotic lines not passing toward condyles across prosternal corner, appearing exactly as in fig. 4(e). Prehensors: without articular denticles; claw distally concave. Tergites: except the first two and last each conspicuously bisulcate; major paratergites absent; intercalary paratergites present and readily seen at least on the anterior body third. Pleurites: no stigmopleurite fused with adjacent plates; spiracles at least of anterior body half each distinctly vertically elliptical, the lower arc of each narrower than the upper (hence each is rather egg-shaped in outline), no spiracle is circular; intercalary pleurites very large, overlapping sides of intercalary tergites, at least on posterior third of body. Sternites: pore-fields on sternites 2 through penultimate; without pouches, fossae, etc. Ultimate segment: pretergite separated from very large intercalary pleurites; tergite broadly trapezoidal; sternite no broader than long, posterior margin deeply emarginate, sides gently convergent; each coxopleuron with 3 ventral pits containing cryptic pore-openings and with 2 elongate dorsal pits also with cryptic pore-openings; legs incomplete but reportedly clawless. Postpedal segments: ♂ gonopods long, very widely separated, each bipartite. Terminal pores absent.

Note C. Gosiphilus and **Californiphilus.**

Lacking adequate material and other evidence, I have not felt justified in re-allocating the species here included under *Gosiphilus*. Quite obviously this arrangement is both unsatisfactory

and tentative. This is all the more apparent from the fact that the type-species of *Gosiphilus* lacks complete prosternal sclerotic lines, though the presence of such lines was supposed to be a signal characteristic of the genus. Should the accumulation of additional information justify a generic division based upon this character *alone,* then perhaps most of the species would take the Verhoeff name, *Californiphilus,* whose type-species does possess complete sclerotic lines. At the same time it is quite likely that the best, and as yet unknown, arrangement is much more complicated than this.

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Types of Tingidae Described by Torre-Bueno (Hemiptera) [1]

By George W. Byers

In 1948, the Snow Entomological Museum of the University of Kansas acquired two outstanding collections of Hemiptera, those of J. R. de la Torre-Bueno and G. W. Kirkaldy. Together with the collections were purchased the extensive libraries of reprints and separate papers accumulated by these two hemipterists. Interpolation of the Torre-Bueno and Kirkaldy specimens into the Snow Museum collection has only recently been completed. It was found at the time of purchase that the Torre-Bueno collection had been extensively damaged by water (as a result of flooding of a basement in which the collection had been stored) and by dermestids. The following notes pertain to the type series of two species of Tingidae found in this collection, which are, as far as I am aware, the only North American species of this family described by Torre-Bueno.

Acalypta lillianis Bueno

1916. A new tingid from New York state. Bull. Brooklyn Ent. Soc., 11 (2) : 39–40.

A box that had contained about eighty pinned tingids, including a part of the type series of this species, was found to have all the specimens detached from the paper points to which they had been glued; the insects lay scattered in the bottom of the box. By reference to the original description and comparison with specimens kindly loaned from the United States National Museum by Dr. Peter D. Ashlock, I isolated from the debris

[1] Contribution No. 1044 from the Department of Entomology, University of Kansas, Lawrence, Kansas.

Collembola from Japan. I. Onychiurinae

By Harold George Scott [1]

During 1951 and 1952, Captain John E. Scanlon [2] collected a number of interesting springtail insects while with the 406th Medical General Laboratory (U. S. Army) in Japan. This is the first of a series of papers reporting on these collections. Specimens will be deposited with the Academy of Natural Sciences, Philadelphia, Pennsylvania.

Onychiurus pseudarmatus Folsom, 1917.

The similarity between this species (not previously recorded from Japan) and the Japanese *Onychiurus yagii* is recognized. However, the Scanlon specimens are clearly *Onychiurus pseudarmatus*.

Japanese Record. From soil of rodent burrow, 23–x–1952, Shizuoka, Subashiri, Honshu, Japan, by J. E. Scanlon.

Distribution. Japan, Alaska (from moss), New York (from leaf mold).

Onychiurus ramosus Folsom, 1917.

The Japanese specimens agree fully with Folsom's description. This species has not been recorded previously from Japan.

Japanese Record. From Berlese funnel sample of soil, bamboo grove in woods, 677 meters altitude, 20–vi–1952, Beppu, Otta Ken, Kyushu, Japan, by J. E. Scanlon.

Distribution. Japan, Ontario, Illinois (among grass roots, in woods under damp logs), Iowa.

Key to the Species of Onychiurinae Recorded from Japan

1. Furcula well developed; body pigmented; adults longer than 5 mm..... *Homaloproctus sauteri* Borner, 1909

[1] Training Branch, Communicable Disease Center, Bureau of State Services, Public Health Service, U. S. Department of Health, Education, and Welfare, Atlanta, Georgia.

[2] Medical Service Corps, U. S. Army. Present address: Department of Entomology, University of Maryland, College Park, Maryland.

Furcula absent or strongly reduced; body generally unpigmented; adults shorter than 5 mm.....2
2. Hind margin of head with pseudocelli.....3
Hind margin of head without pseudocelli.....5
3. Anal spines absent.....*Onychiurus folsomi* (Schaffer, 1900)
Anal spines present.....4
4. Tergites minutely granulate; pseudocellar formula (2 + 2) (0, 1 + 1, 2 + 2) (2 + 2, 2 + 2, 2 + 2, 2 + 2, 2 + 2, 0) ... .*Onychiurus yagii* Kinoshita, 1923
Tergites coarsely granulate; pseudocellar formula (2 + 2) (0, 1 + 1, 1 + 1) (2 + 2, 2 + 2, 2 + 2, 2 + 2, 3 + 3, 0) ... .*Onychiurus pseudarmatus* Folsom, 1917
5. Postantennal organ with about 30 tubercles; integument coarsely granulate...*Onychirus granulatus* (Borner, 1909)
Postantennal organ with about 13–15 tubercles; integument minutely granulate.....6
6. Unguiculus much less than one-half length of unguis; postantennal tubercles simple..... .....*Onychirus tomuraushensis* (Yosii, 1940)
Unguiculus approximately half length of unguis or longer; postantennal tubercles many lobed..... .....*Onychiurus ramosus* Folsom, 1917

Summary

Onychiurus pseudarmatus and *Onychiurus ramosus* are recorded for the first time from Japan. A key to the species of Onychiurinae known from Japan is presented.

Japanese Summary

(By Dr. Shinichi Matsuda, Chief, Department of Epidemiology, Institute of Public Health, Ministry of Health and Welfare, Tokyo, Japan.)

二種のSpringtail昆虫(Collembola), すなわち Onychiurus pseudarmatus と Onychiurus ramosus が, 日本で初めて記録された. そして日本で Onychiurinae が発見された鍵が提示された.

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Note on the Rearing of Thysanus fasciatus (Hymenoptera: Thysanidae) from Melanaspis lilacina (Homoptera: Diaspididae) in California

By P. H. ARNAUD, JR., Bureau of Entomology, California Department of Agriculture, Sacramento

Melanaspis lilacina (Cockerell) is considered to be a rare scale in California, having been recorded so far from only two California localities in San Diego County—Banner, in 1939, and Descanso, in 1955 (McKenzie, H. L., 1956, Bull. Calif. Insect Sur., 5: 77). The thysanid parasite here recorded was reared from the latter collection. From a small collection of a half dozen adult scales of *M. lilacina* (det. confirmed, H. L. McKenzie) collected on *Quercus* sp. at the Sherilton Ranch, Descanso, 30 November 1955, by G. W. Schwegel and J. P. Dion, a single female specimen of *Thysanus fasciatus* (Girault) (det. B. D. Burks) was reared by the writer. Its pupa was discovered under one of the scale covers previous to its emergence. This is very probably a primary parasite, as De Bach, Kennett and Pence (Jour. Econ. Ent. 51(1): 114–115, 1958) have recently recorded rearings of *Thysanus merceti* (Malenotti) and *T. thoreauini* (Girault) from armored scales as primary parasites. *Thysanus fasciatus* was originally described from Mexico, and in the United States is known to occur in Texas.

Variation in the Ant Polyrhachis thrinax (Hymenoptera)

By W. L. Brown, Jr., Museum of Comparative Zoology

Polyrhachis (Myrmothrinax) thrinax Roger

Polyrhachis thrinax Roger, 1863, Berlin. Ent. Zeitschr. 7: 152, worker. Type loc.: Ceylon.

Polyrhachis (Myrmothrinax) thrinax var. *mucronis* Donisthorpe, 1942, Ann. Mag. Nat. Hist. (11) 9: 460, worker (stated in error to be female). Type loc.: Nadungayam, 200 feet, Malabar, S. India. New Synonymy.

Donisthorpe states, "In this variety the central spine on the petiole is simple instead of being bimucronate as in the typical form." In a type of *mucronis* received from the British Museum, however, I find that the tip of the central spine is actually finely bimucronate. The Nadungayam specimen, a few workers from Bombay (*ex.* G. B. King Coll.), and two nest series from Jorhat, Assam (A. C. Cole *leg.*) show some variation in the breadth of the apex of the spine, as well as in other minor characters, but there is nothing exceptional in this for a *Polyrhachis*.

Notes and News in Entomology

Under this heading we present, from time to time, notes, news, and comments. Contributions from readers are earnestly solicited and will be acknowledged when used.

Michigan State List in Preparation. According to the steering committee (R. R. Dreisbach, Roland Fisher, J. H. Newman, George Steyskal, and Henry Townes) work has begun on a list of insects, arachnids, and other land arthropods of Michigan. Records of about 17,000 species and 85,000 individual county occurrences are on hand. Additional records with authentic determinations, specialists to advise, and, in some areas, to take responsibility for taxonomic groups are needed. Typed copy is to be ready for specialists by January 1960, and for final typing by January, 1962. Mr. R. R. Dreisbach is general editor and communications may be addressed to him at 301 Helen Street, Midland, Michigan.

Review

A RECLASSIFICATION OF THE ORDER ODONATA. By F. C. FRASER. The Royal Zoological Society of New South Wales, 1957. 133 pp., 63 figs.

R. J. Tillyard's concept of Odonata classification, which was annotated, completed and posthumously published by F. C. Fraser in 1938–40 (A reclassification of the Order Odonata, based on some new interpretations of the venation of the dragonfly wing. Australian Zool. 9: 125–169; 195–221; 359–396), has been revised by Fraser. Updating of this significant study is occasioned by (1) subsequent discoveries of fossil Odonata in Oklahoma and Kansas, (2) re-examination by Carpenter of Commentary fossil wings initially and inaccurately described and figured by Brongniart and by Meunier, (3) finding of nymphs of the archaic genera *Chorismagrion* and *Lestoidea* by Dobson and (4) study of evolutionary and ontogenetic development of the subcostal and anal veins by Fraser. A considerable part of the present work is essentially a reprint of the earlier with Fraser's previous footnote annotations incorporated in the body of the text. Usually in identifiably new paragraphs are interpolated Fraser's views (some previously published), systematic rearrangements and elucidating comments on the differing concepts of Tillyard and Carpenter regarding ancestral Odonata. None of the figures appears to be new although there is reinterpretation of some, especially that of the wing of the ancestral *Protagrion audouini*.

Controversial in the study of Odonata evolution has been the source of the Anisozygoptera and their descendents, the Anisoptera. Tillyard's original view was that the broad-based wing of anisopterous forms derived from narrow-petioled zygopterous types by means of recurrent branches thrown off from the stem of the anal vein which was fused at its base with the posterior cubitus (Cu_2) in both suborders. This view yielded, prematurely according to Fraser, to a concept of dual origin held by Carpenter and based on his studies of the Permian Protanisoptera. It is Carpenter's contention that the Anisoptera

derived from the Protanisoptera, forms in which the anal vein was independent of the posterior cubitus, and that the Zygoptera, having the anal vein fused with the posterior cubitus, arose from the Protodonata independently of the Anisoptera through protozygopterous types. As Fraser points out, adherence to Carpenter's thesis necessitates acceptance of a parallelism of evolution in so many venational structures as to be incredible. It is, as well, a thesis which neither explains why the forewing of the Anisozygoptera is zygopterous while the hindwing is anisopterous nor accounts for the existence of zygopterous structures in present-day Anisoptera. Largely on the basis of these vestigial characters, and reinforced by the fossil record and acceptance of Lameere's ancestral Palaeopterous type of wing-venation, Fraser proposes that the Anisoptera have, in their descent from the Protodonata, passed through a zygopterous stage and that the anal vein arises independently of the posterior cubitus from the base of the wing in both extant suborders.

The present classification is consistent with his hypothesis, and reflects, in so far as it can, Fraser's views on evolution within the palaeopterous Odonata. The starting point of separation from the Protodonata is held likely to be *Eresipteron* (Suborder Meganisoptera), a point proposed earlier by Carpenter. From the Meganisoptera arose two lines, the successful Protozygoptera and, according to Fraser, a dead end, the Protanisoptera. It was because of the seeming foreshadowing within this latter group of libelluloid and aeshnoid features that Carpenter (and later Tillyard) proposed this group as the direct precursors of the Anisozygoptera, and hence Anisoptera. Although Fraser argues well his point that the Protanisoptera indeed constituted an evolutionary blind alley, this is a locus likely to be controversial for some time. Fraser then considers that the Protozygoptera, in addition to bearing an unsuccessful side-branch, the Archizygoptera, gave rise also to the Zygoptera from which developed the Coenagrioidea, Hemiphlebioidea and Lestinoidea. The Agrioidea and Anisozygoptera separated from the Lestine complex, according to Fraser.

In addition to this main evolutionary stream and resulting therefrom, there are several noteworthy and probably controversial items of classification: (1) a further development of Fraser's previously published account on the position of his new family Macrodiplactidae (*Macrodiplax, Urothemis, Aethriamanta* and *Selysiothemis*) as a natural annectant between the Corduliidae and Libellulidae; (2) a consideration of the Synthemidae as a link between Corduliidae, in which these archaic forms were previously included, and Cordulegasteridae, bringing the latter into the orbit of the Libelluloidea; (3) a splitting of the hodge-podge Megapodagriidae with inclusion of that family in the Lestinoidea; (4) a discussion of the relationship of Agrioidea to Lestinoidea based largely on the amphipterygine-like nymph of *Lestoidea conjuncta.* It is significant to point out that the last point is one of the very few instances in which characteristics of the larval form are brought to bear on the systematics of the group, for it reflects the regrettable paucity of critical studies on immature dragonflies.

Whereas the wings and wing venation are of greatest importance in recognition of orders and families of insects and these are the very parts generally preserved as fossils, there should be no overlooking the importance of the potential value of thorax (for evidence on changes in obliquity and obliteration of sutures), tarsi (for numbers), head (for fusion of the eyes over the vertex), terminal abdominal portions (for changes occasioned by the progressive loss of endophytic oviposition) and larvae, the characters of which may be more representative of evolutionary struggle. No ecological and only scant zoogeographical evidence is brought to bear on the problem. The present study has dealt considerately with what evidence obtains; that it is deficient in ancillary evidence is immediately recognizable. Occasional typesetting and editing errors do not and could not very well detract from the significance of this study in increasing the student's understanding of the group. —Edward J. Kormondy

EXCHANGES

This column is intended only for wants and exchanges, not for advertisements of goods for sale or services rendered. Notices not exceeding three lines free to subscribers.

These notices are continued as long as our limited space will allow; the new ones are added at the end of the column, and, only when necessary those at the top (being longest in) are discontinued.

Bembicini and Stizini (Hym., Sphec.) of New World wanted for revis. study. Will return upon request or at end of project. James E. Gillaspy, Dept. of Zoology, Univ. Texas, Austin 12, Texas.

Agapema galbina. Will exchange cocoons of this moth for nature books. E. Frizzell, Route 4, Box 96, San Benito, Texas.

Tenebrionidae of the World wanted, in exchange for insects of Argentina and neighboring countries. Horacio J. Molinari, Av. Lib. Gral. San Martin 55, Acassuso (Buenos Aires), Rep. Argentina.

Butterflies. Wish to exchange specimens for Japanese species. Please write to Ichiro Nakamura (Boy, age 16), 26 Aza-Nichiyama Obayashi Takarazuka-shi, Hyogo-Ken, Japan.

Phasmidae of nearctic area desired alive. Purchase or trade, drawing on large stock of major orders, worldwide. Domminck J. Pirone, Dept. Entomology, Cornell University, Ithaca, N. Y.

Nitidulidae and Rhizophagidae wanted in exchange for European beetles of all families. O. Marek, Zămberk 797, Czechoslovakia.

Wanted and Needed. We are compiling a history of entomology, and particularly, at present, of the amateur insect clubs that flourished 50 to 75 years ago. Will you who have knowledge of such early clubs or societies advise me, giving facts on the time of existence, members, etc., which you may have. J. J. Davis, Dept. of Entomology, Purdue University, Lafayette, Indiana.

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Number 16

A TAXONOMIC STUDY OF THE NORTH AMERICAN LICININI WITH NOTES ON THE OLD WORLD SPECIES OF THE GENUS DIPLOCHEILA BRULLE (COLEOPTERA)

By George E. Ball

258 pages of text, 75 tables, 3 diagrams, 15 plates, table of contents and index

This monograph considers the geographical variation, relationships, evolution and taxonomy of the carabid tribe Licinini. A general treatment, explaining the taxonomic approach used, definition of terms, criteria for delimiting species and subspecies, etc., precedes the systematic position. The genera *Diplocheila* (subgenera *Diplocheila, Neorembus, Isorembus*), *Dicaelus* (subgenera *Paradicaelus, Dicaelus, Liodicaelus*) and *Badister* (subgenera *Badister, Trimorphus, Baudia*) are each treated in some detail. Keys to the genera and species are given throughout as well as a description (or diagnostic notes), variation, distribution and frequently locality records for each of the forms treated. The phylogeny and zoogeography of each genus are discussed in a separate section. Variation of mensurable characters is treated in the 75 tables. Fifteen plates depict structural (including genitalia) and variational features of the species discussed.

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